The SOMMA model: cortically inspired maps for multimodal learning

Mathieu Lefort, Yann Boniface, Bernard Girau

The SOMMA model: cortically inspired maps for multimodal learning

Mathieu Lefort, Yann Boniface and Bernard Girau
{lefort,boniface,girau}@loria.fr

Aim:

- to learn correlations (meaning recurrent spatial patterns) from a multimodal data flow
- to generalize these correlations in order to adapt to unknown situations

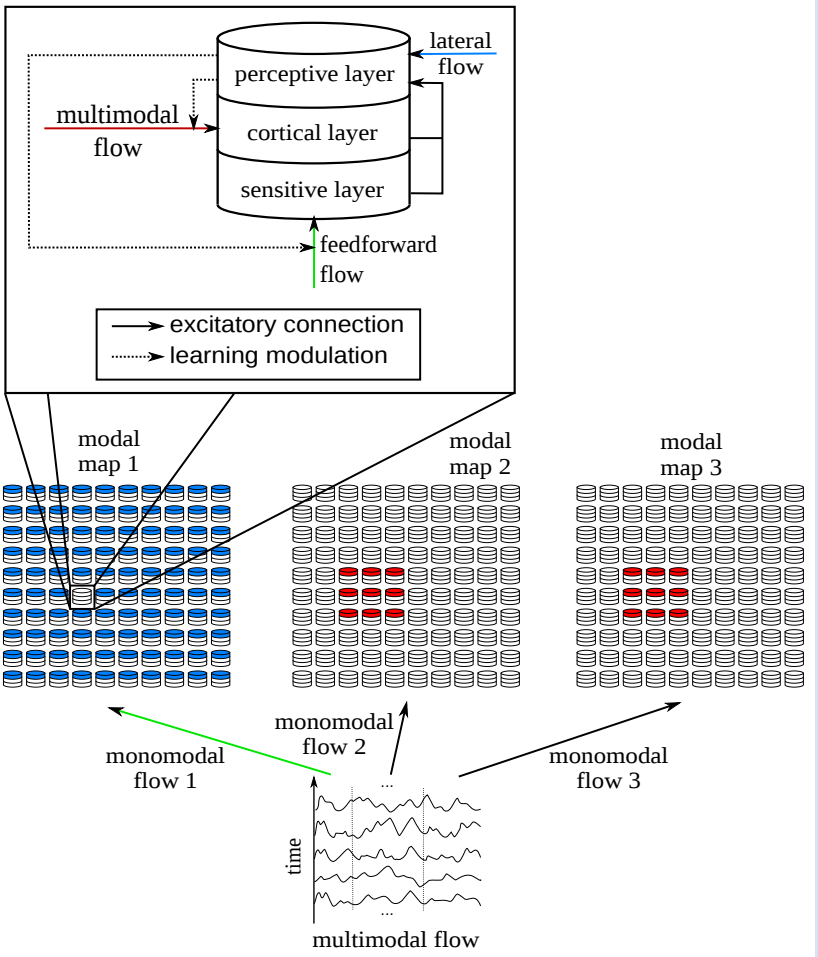
Constraints:

- connectionist paradigm: computation is local, generic and decentralized
- learning is continuous and unsupervized

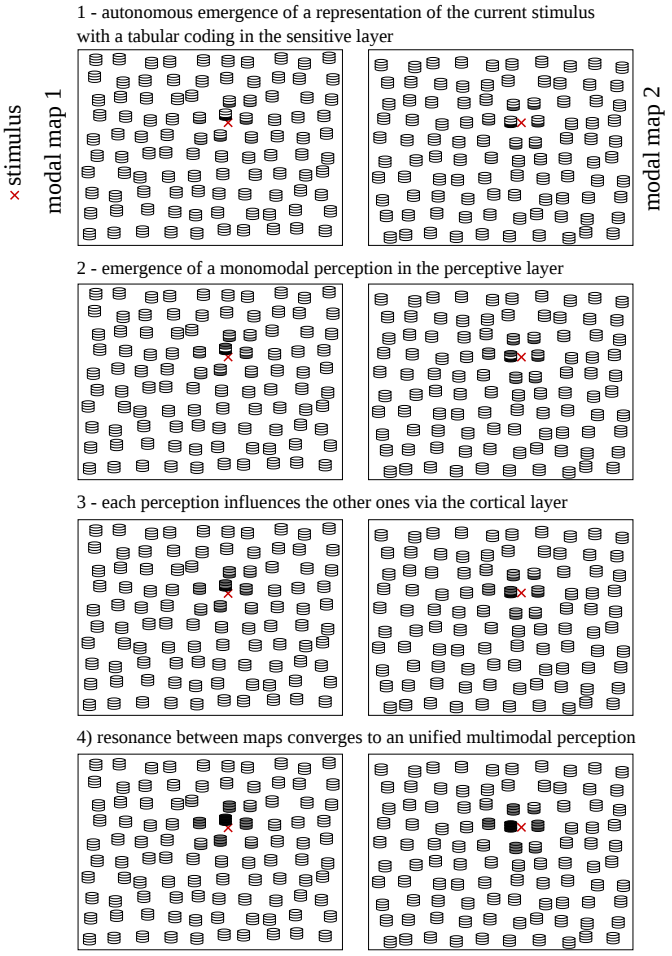
Means:

1) splitting of the data flow into multiple monomodal flows
2) self-organization of monomodal correlations in low dimension topology
3) reciprocal and topological connections between monomodal maps
4) learning of multimodal correlations by constrained monomodal self-organizations

Architecture:



Dynamics:



Model description:

- sensitive layer provides a tabular coding of the current stimulus
- cortical layer provides information from the other monomodal perceptions
- perceptive layer (dynamic neural fields) represents, by a spatial coding, the perception of the current stimulus as a consensus between the local (monomodal) and the multimodal activities

Learning description:

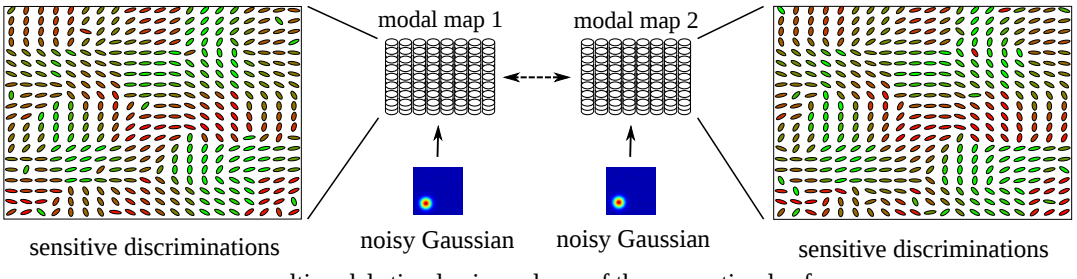
afferent weights:

- BCMu learning rule: discrimination of a correlation in the feedforward flow
- modulation by the perceptive activity combined with a synaptic regulation term: provides the multimodal self-organization of the discriminations

multimodal weights:

Widrow Hoff learning rule: the cortical activity converges on the perceptive one

Results:



a multimodal stimulus is made up of the same stimulus for each modality (here a Gaussian whose location is random)

The bidimensional localisation of each sensitive discriminated Gaussian is represented by the orientation and the color of the bar.

We can observe
1) the self-organization of the modal correlations in each modal map
2) as the same input is provided to both maps, the learning of multimodal correlations forces the modal self-organizations to be similar